

Jet Energy Calibration with QCD jet events

S. Arcelli, UMD
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Introduction

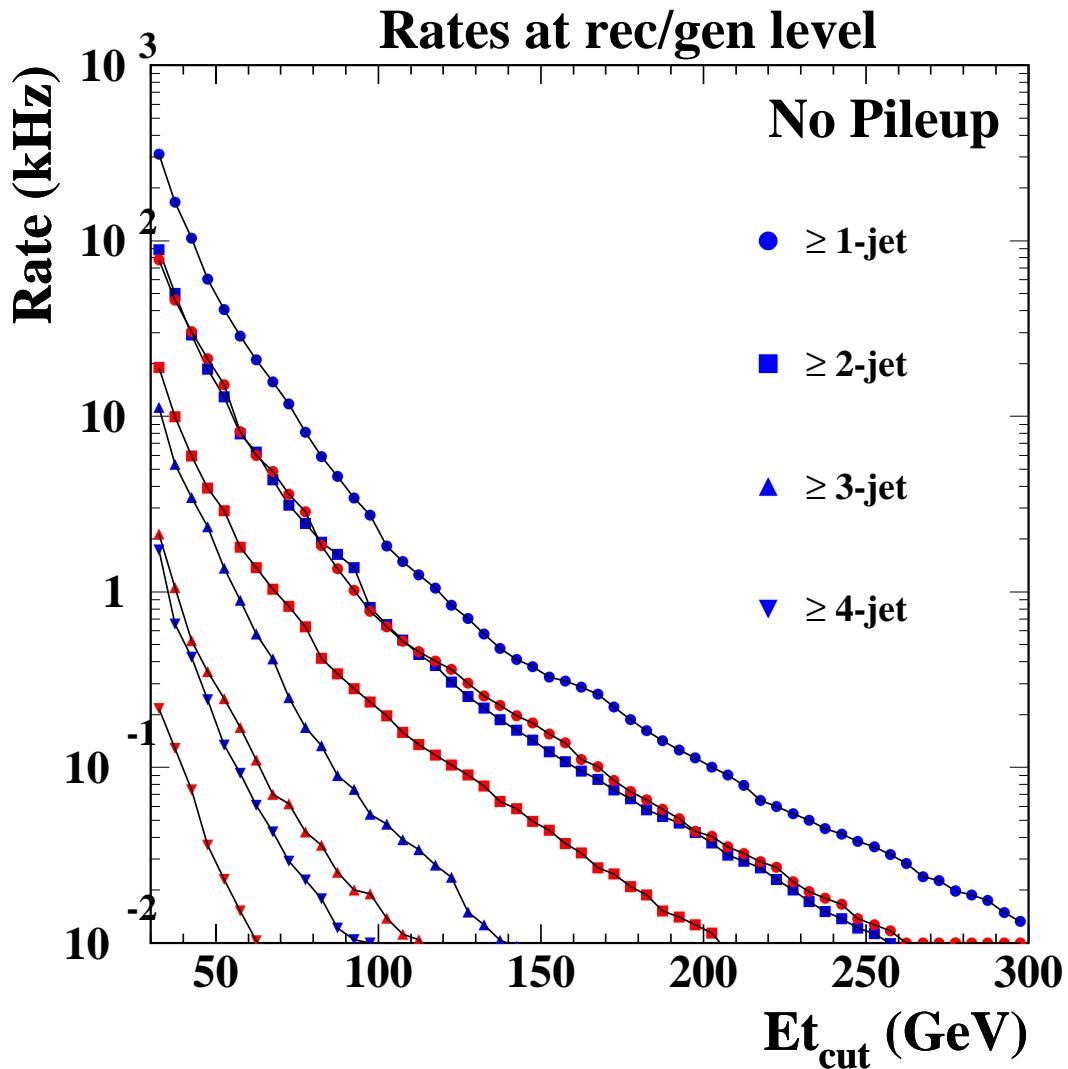
Jet energy reconstruction is affected by non-linearity in HCAL and by extra energy from pile-up.

Use QCD jet events to determine corrections for non-linearity and pile-up contribution on jet energies, to improve energy scale and resolution.

Can help in better understanding:

- Jet trigger rates
- Missing ET calculation
- Improve di-jet mass resolution

Example: Jet Trigger rates

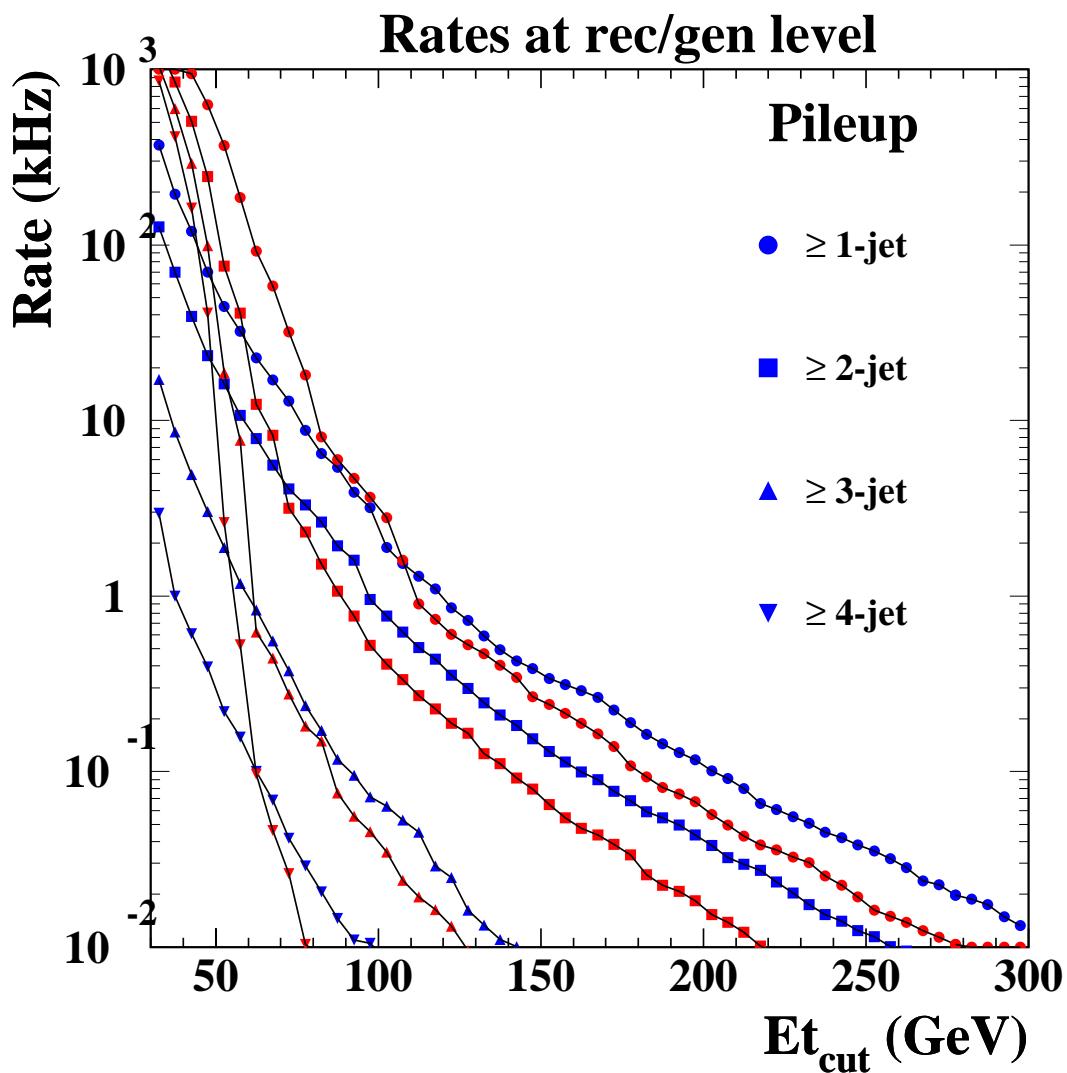


Miscalibration affects the individual jet rates threshold by ≈ 25 GeV at 1 kHz

Jet Trigger rates, pileup

In addition to HCAL scale miscalibration, two effects due to pileup:

- Overestimate of “genuine” jets Et
- Extra low-Et pileup jets



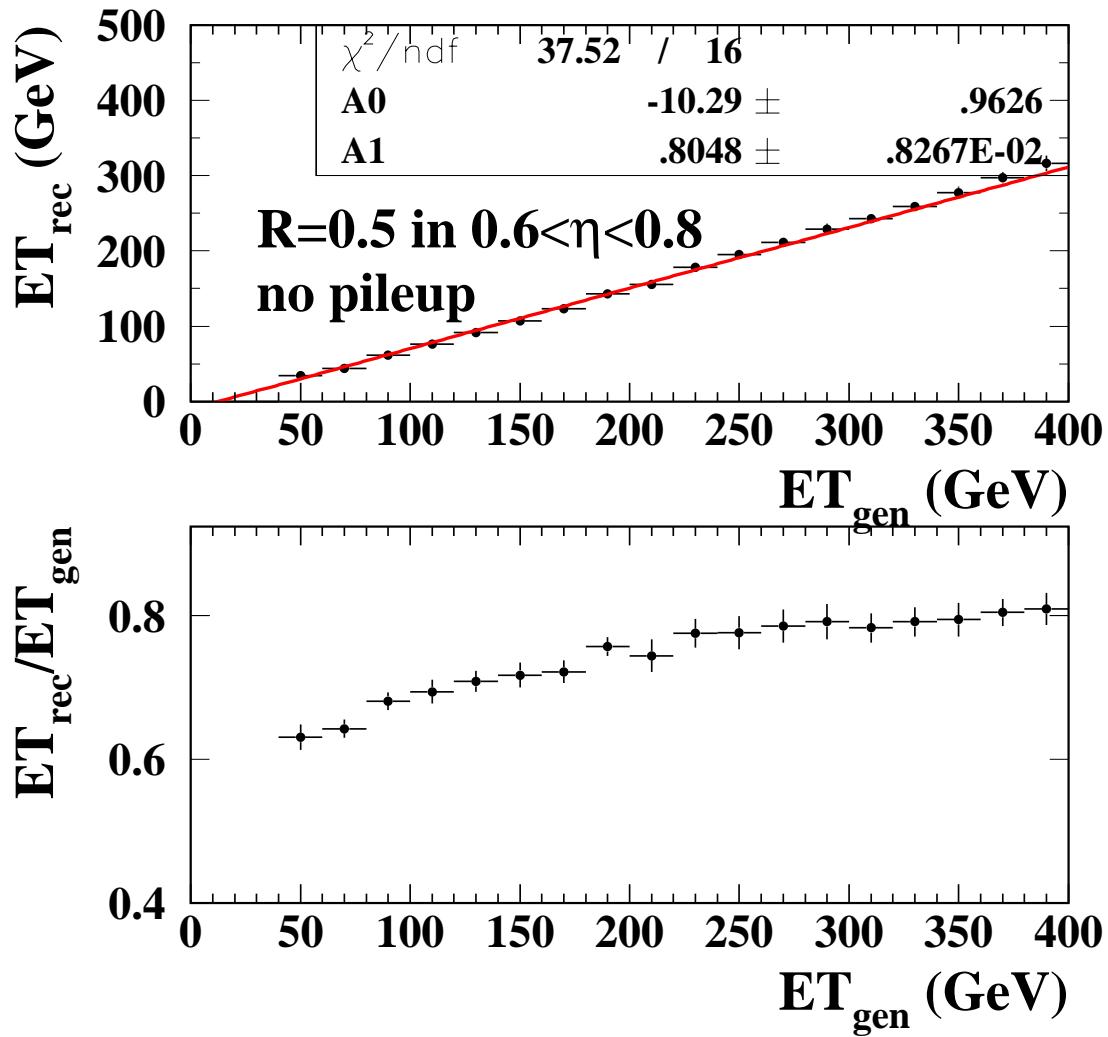
Method:

Fit E_T^{rec} vs E_T^{gen} in each η bin (steps of 0.2 in η):

$$E_T^{\text{rec}} = p1 \cdot E_T^{\text{gen}} + p0$$

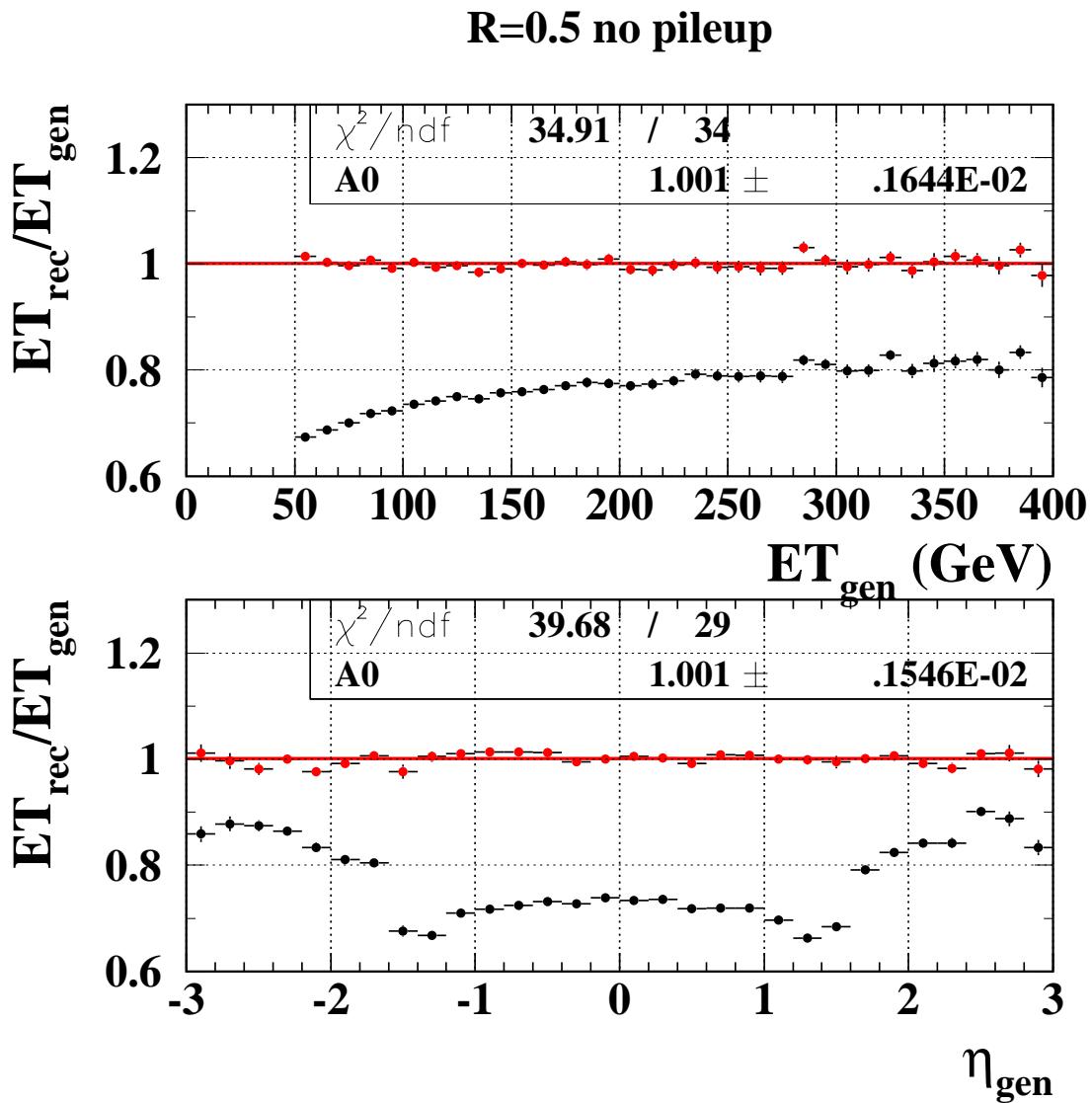
- Corrections derived HB/HE in $|\eta| < 3$ for cone sizes $R = 0.5/0.6/0.7$, with and without pileup.
- Use all good gen-rec matching jets in the event
- Rec jets use EcalplusHcal Towers input

No pile-up case



negative offset reflects non-linearity at low E_T .
 p_1 ranges from 0.8-0.95 depending on η , p_0 is typically -10 GeV.

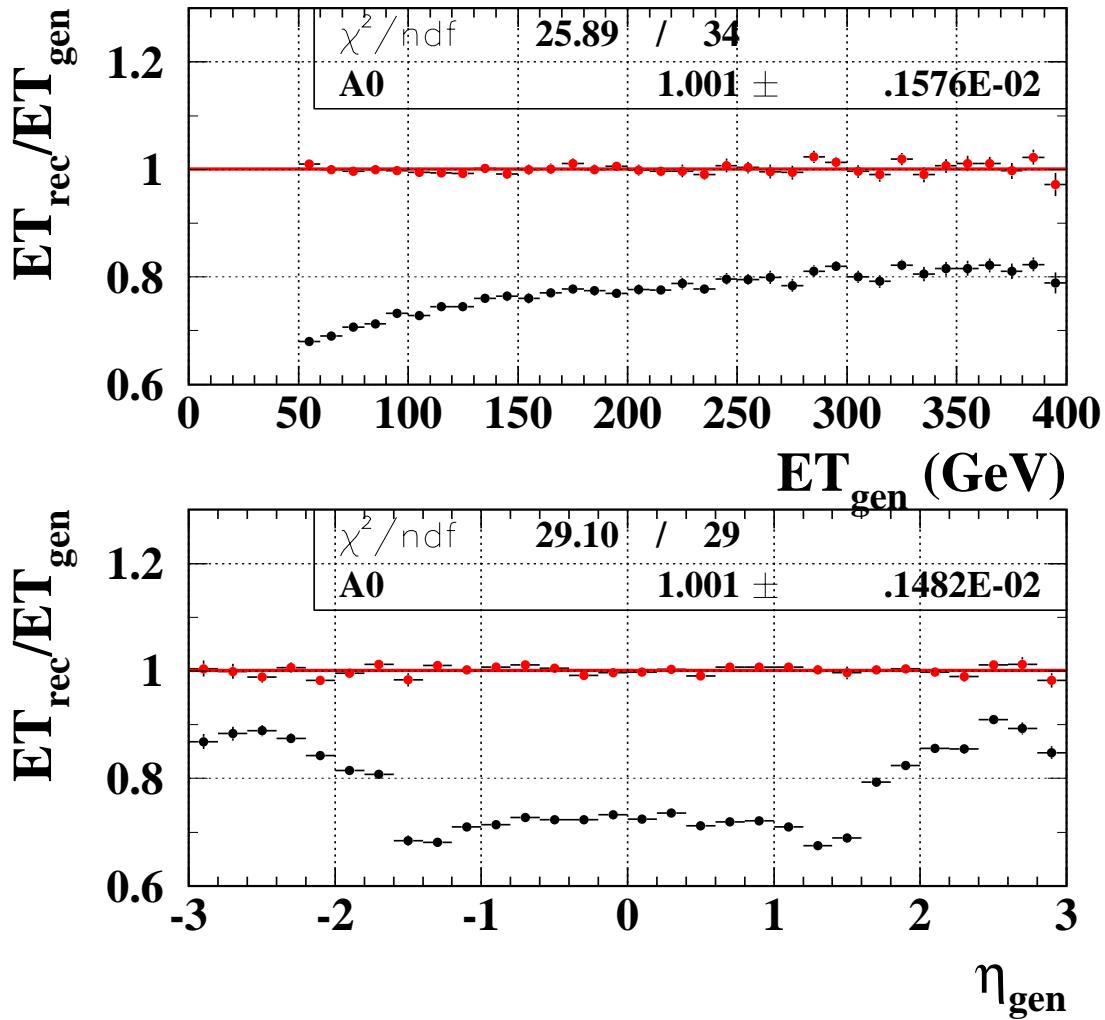
Corrected scale flat within $\approx 1\text{-}3\%$ both in E_T and η .



fit parameters quite independent from the cone size (typical consistency $p1 \approx 0.5\%$, $p0 \approx 0.5$ GeV)

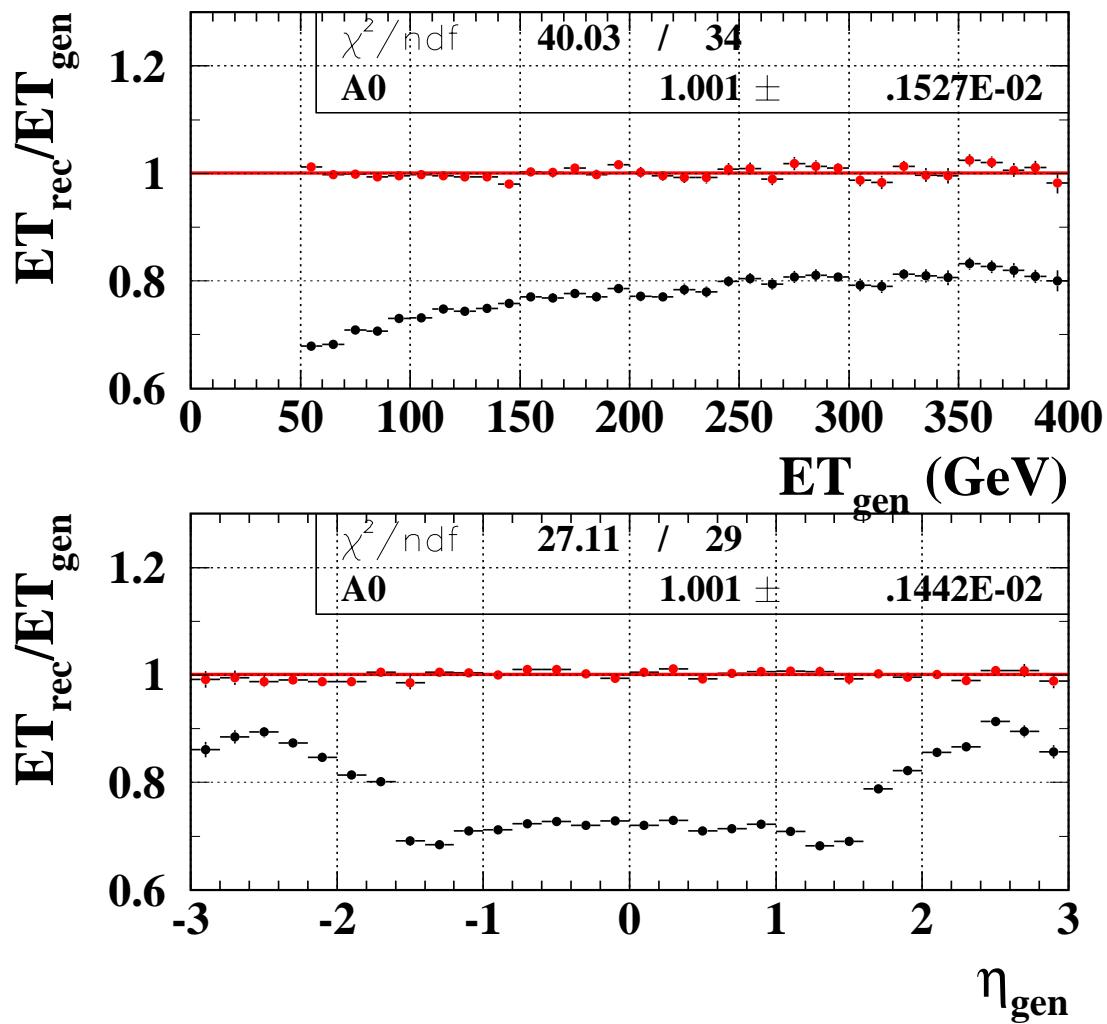
No pile-up case R=0.6

R=0.6 no pileup



No pile-up case R=0.7

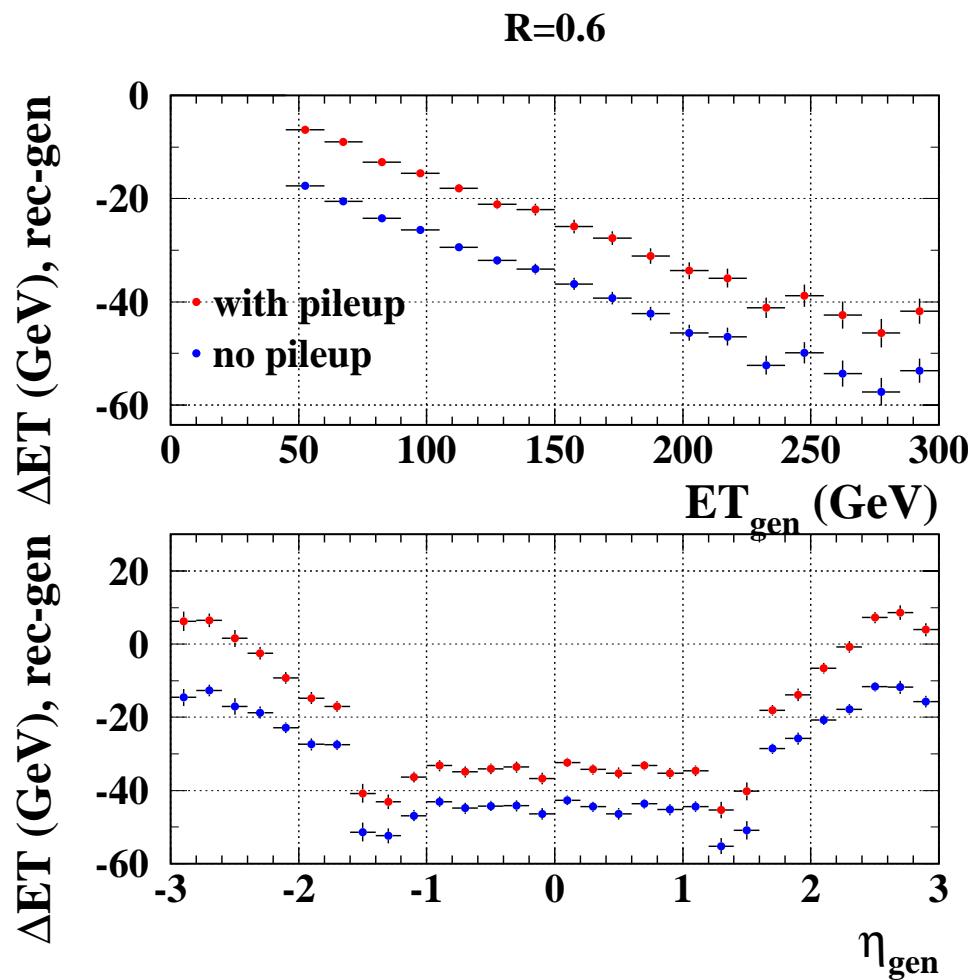
R=0.7 no pileup



Pile-up case

On average, pile-up adds constant E_T as a function of E_T . In η , the additional pile-up E_T is flat in the HB region but grows with η in HE.

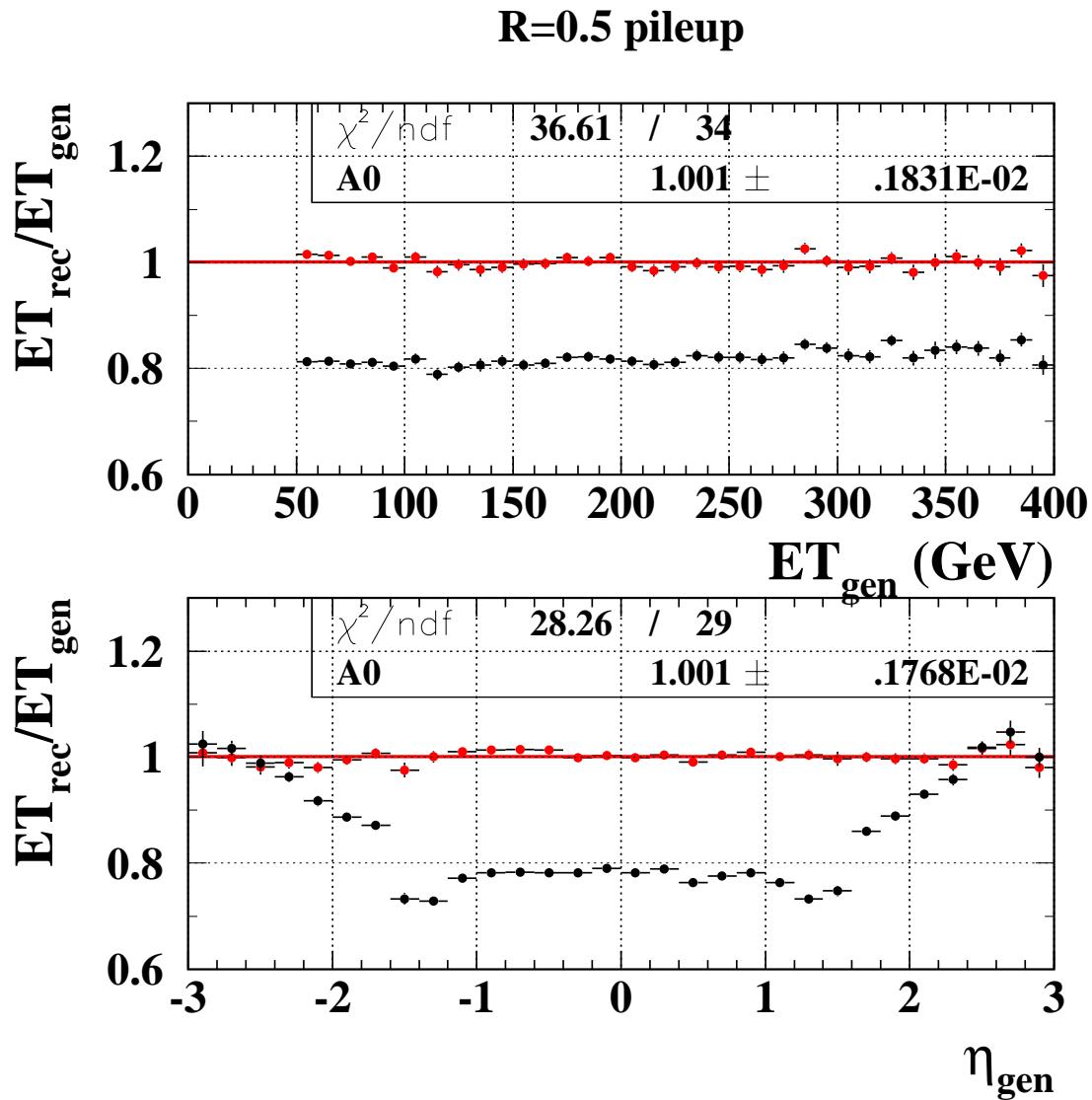
The extra pile-up E_T grows with the cone size (as $\approx 2.5 \text{ GeV}/dR=0.1$)



Same method as for non-pileup is used to derive average corrections

Scale parameter p1 quite independent from the cone size and consistent with non-pileup case.

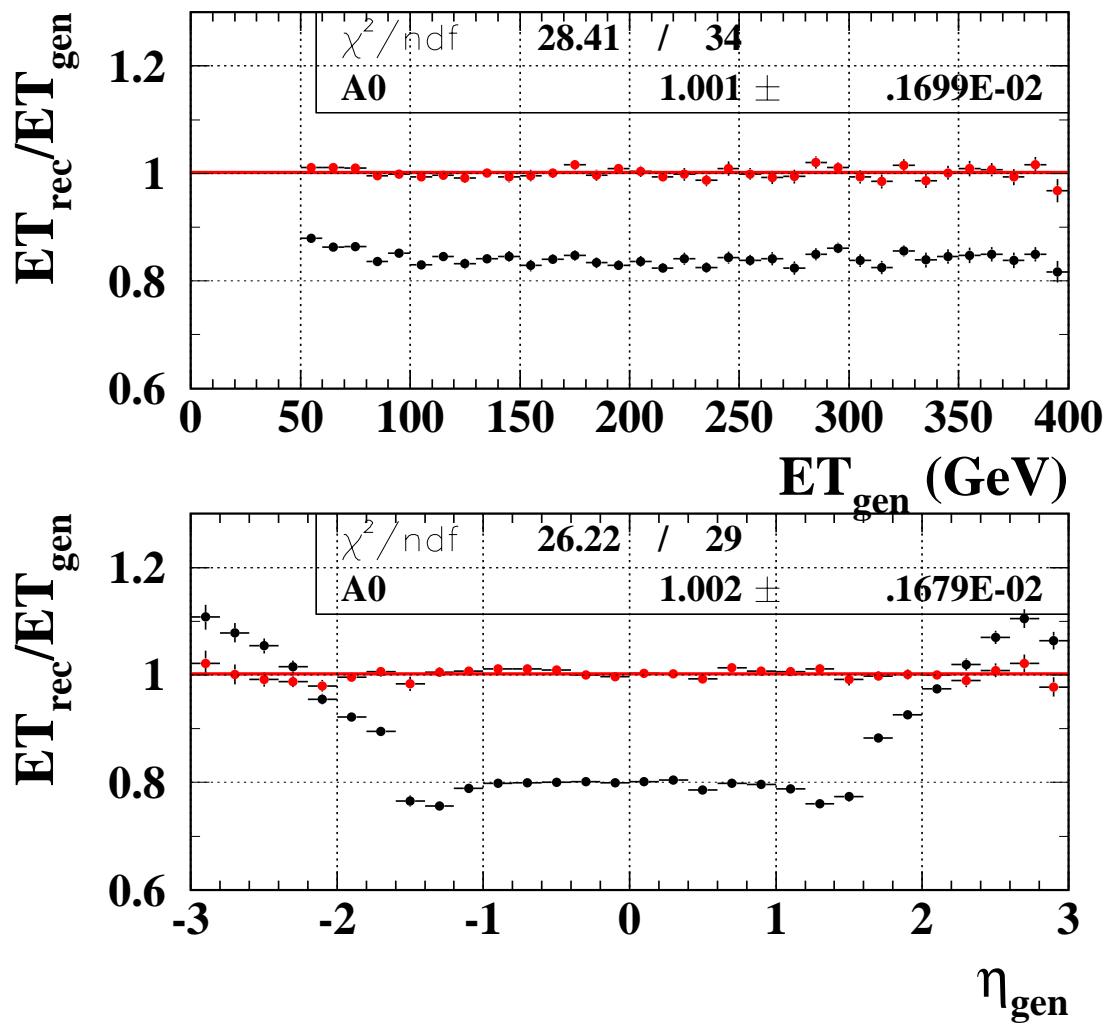
The offset parameter p0 depends significantly on the cone size due to different extra pile-up contribution.



Corrected scale again flat within $\approx 1\text{-}3\%$ both in E_T and η .

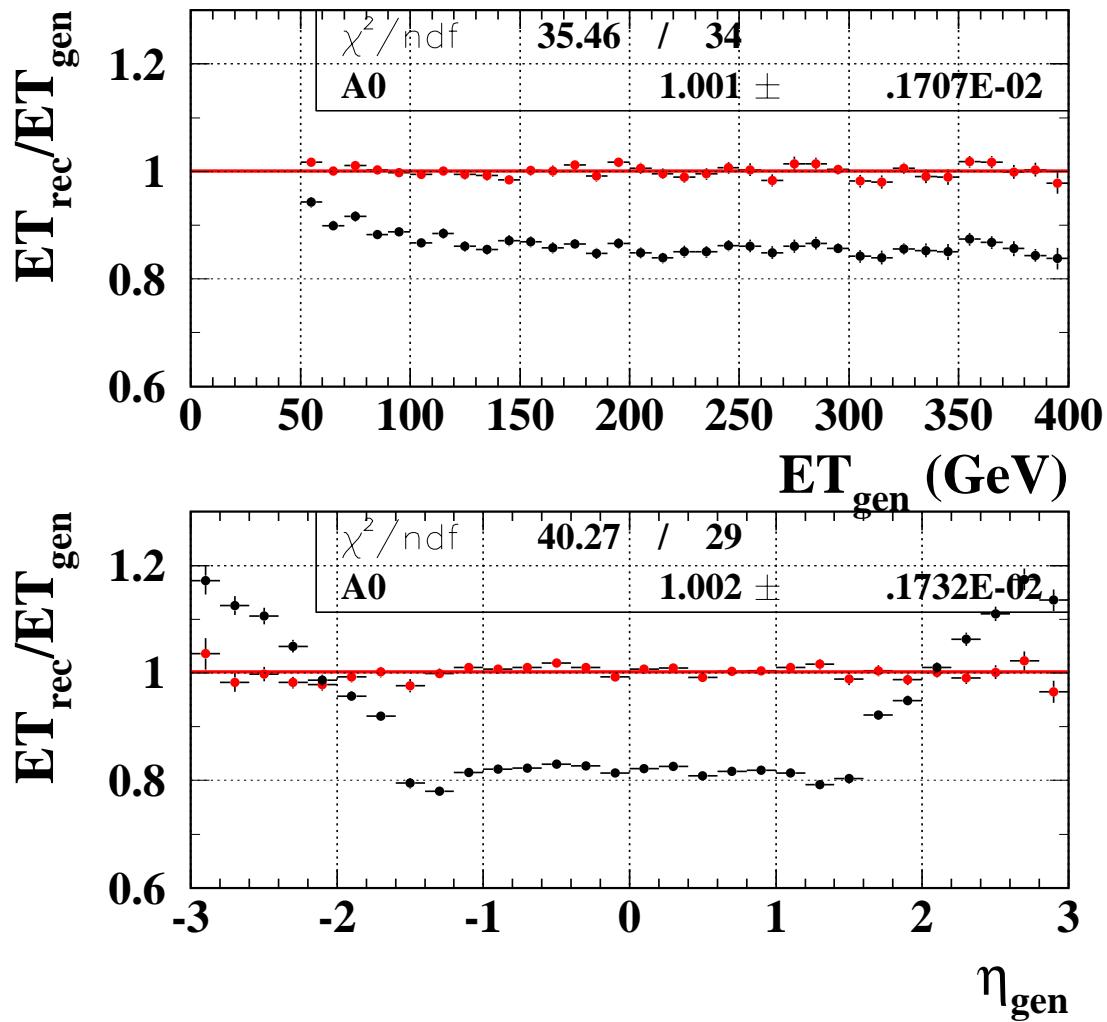
Pile-up case R=0.6

R=0.6 pileup



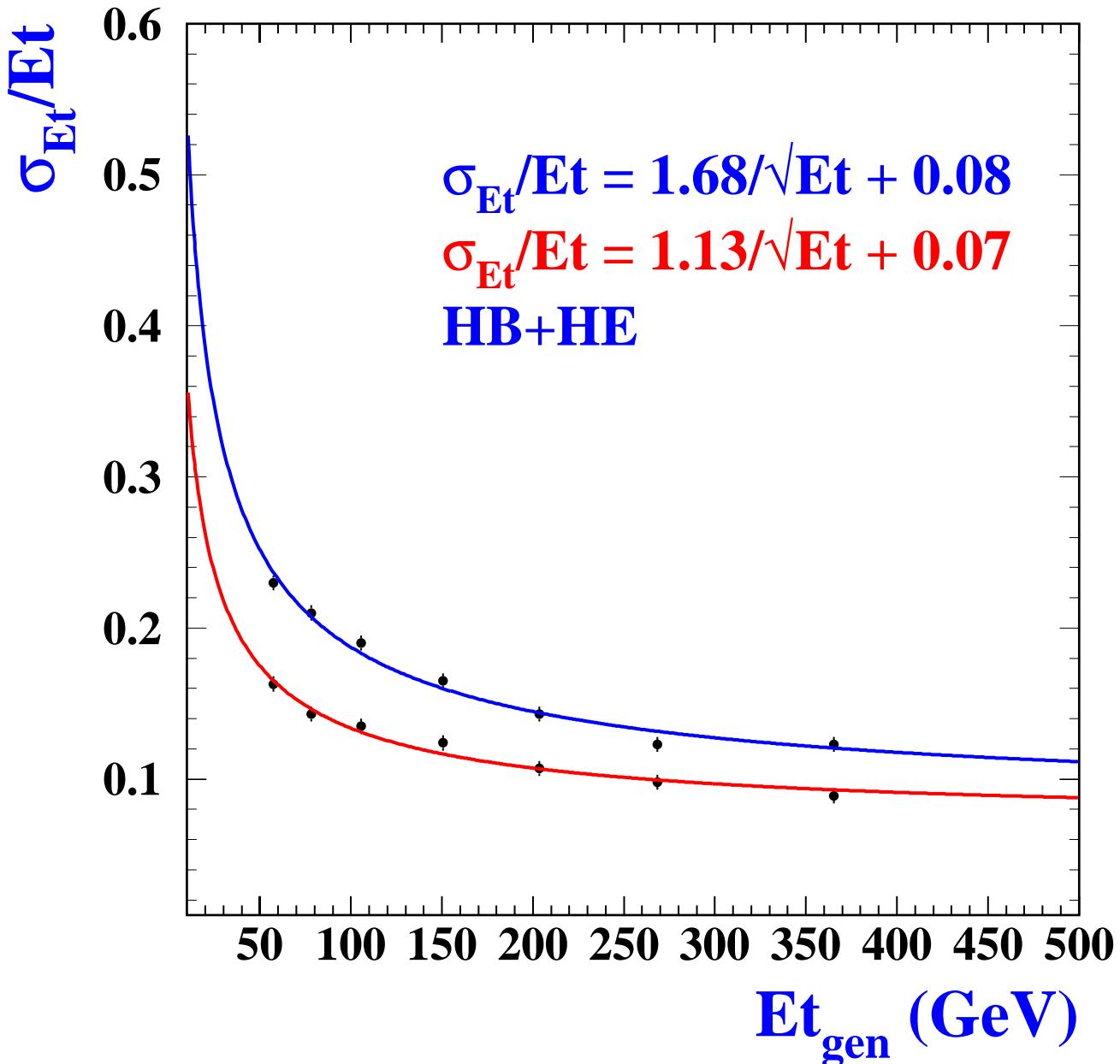
Pile-up case R=0.7

R=0.7 pileup



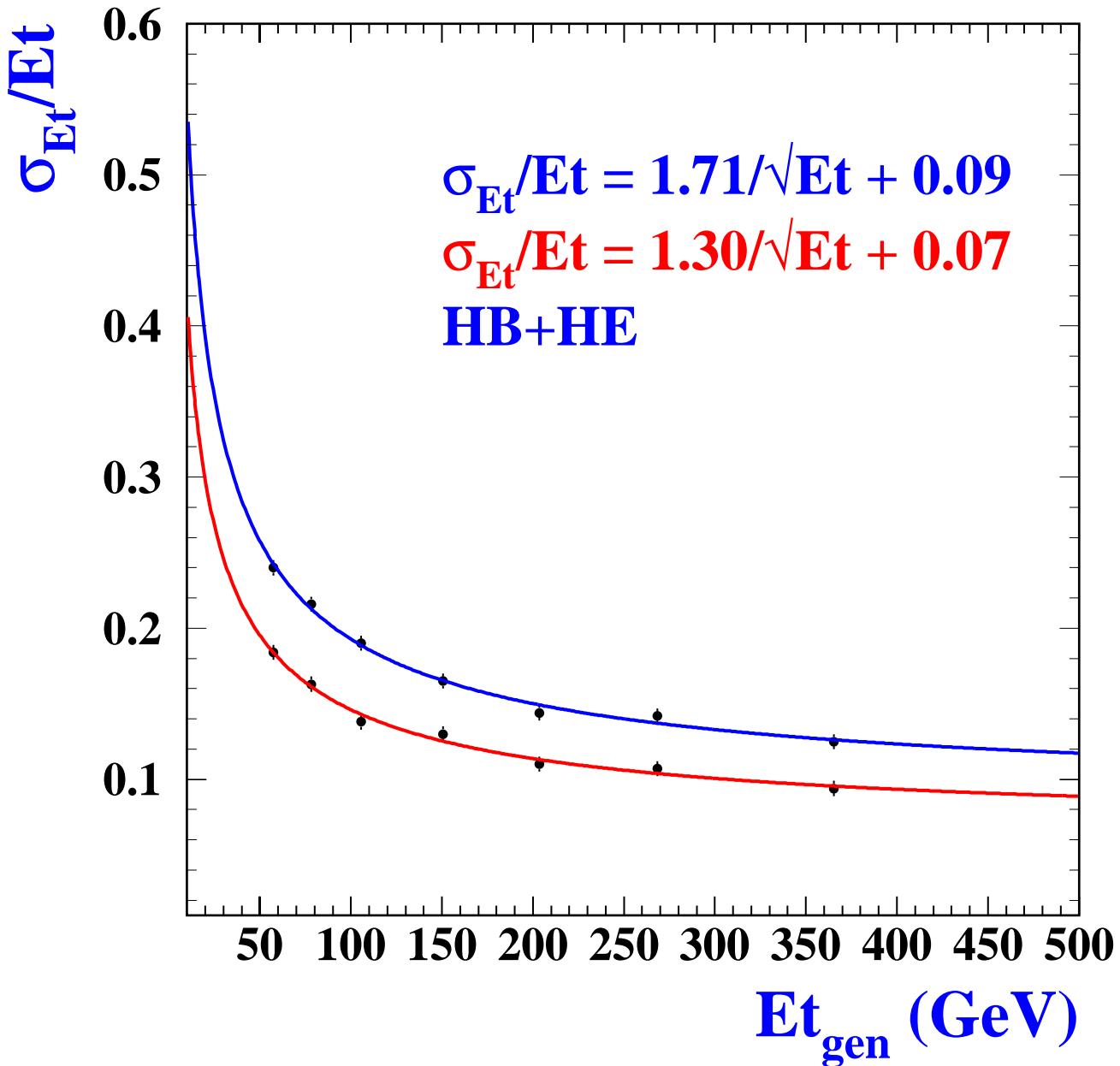
Resolution, no pileup

cone R=0.5, no pileup

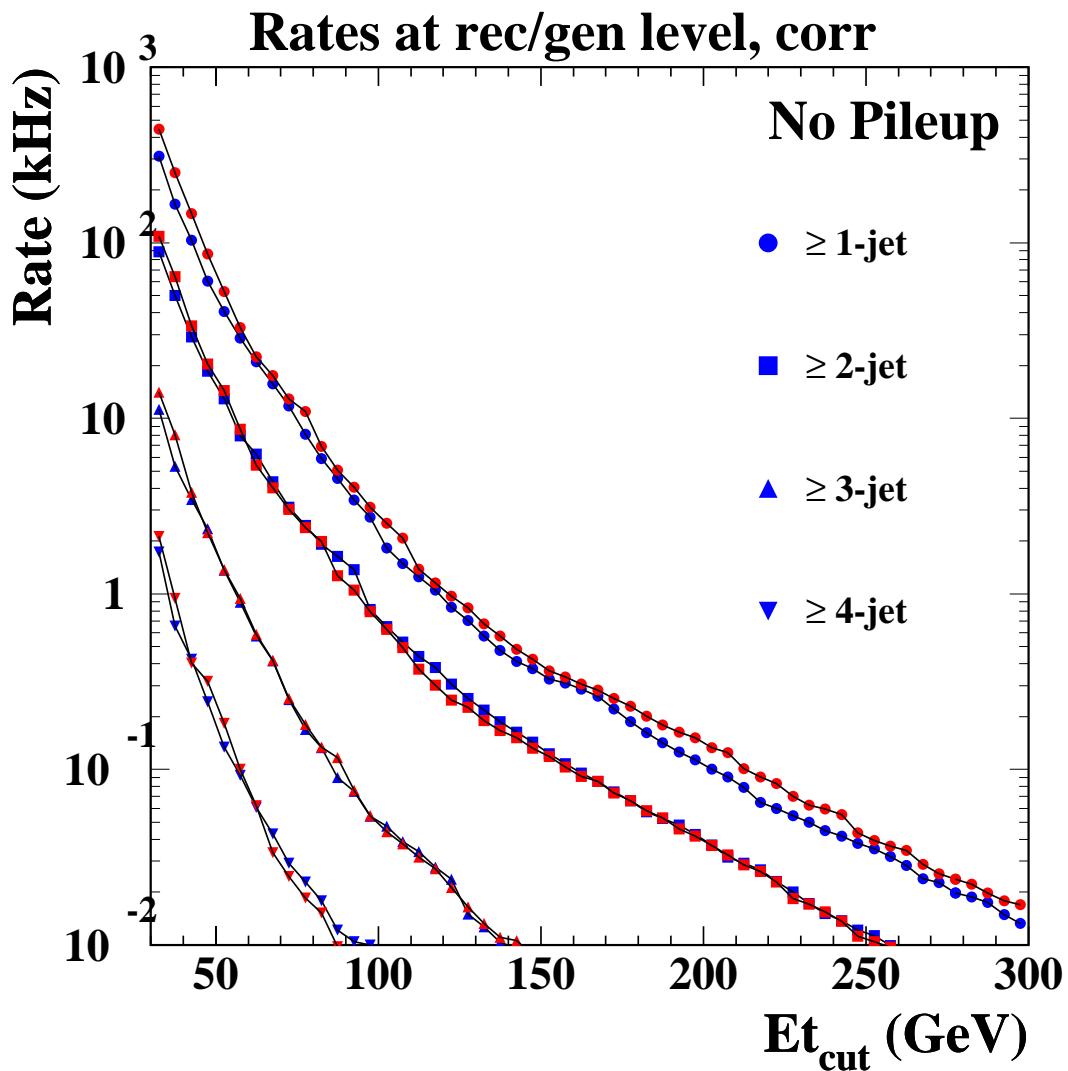


Resolution, with pileup

cone R=0.5, pileup

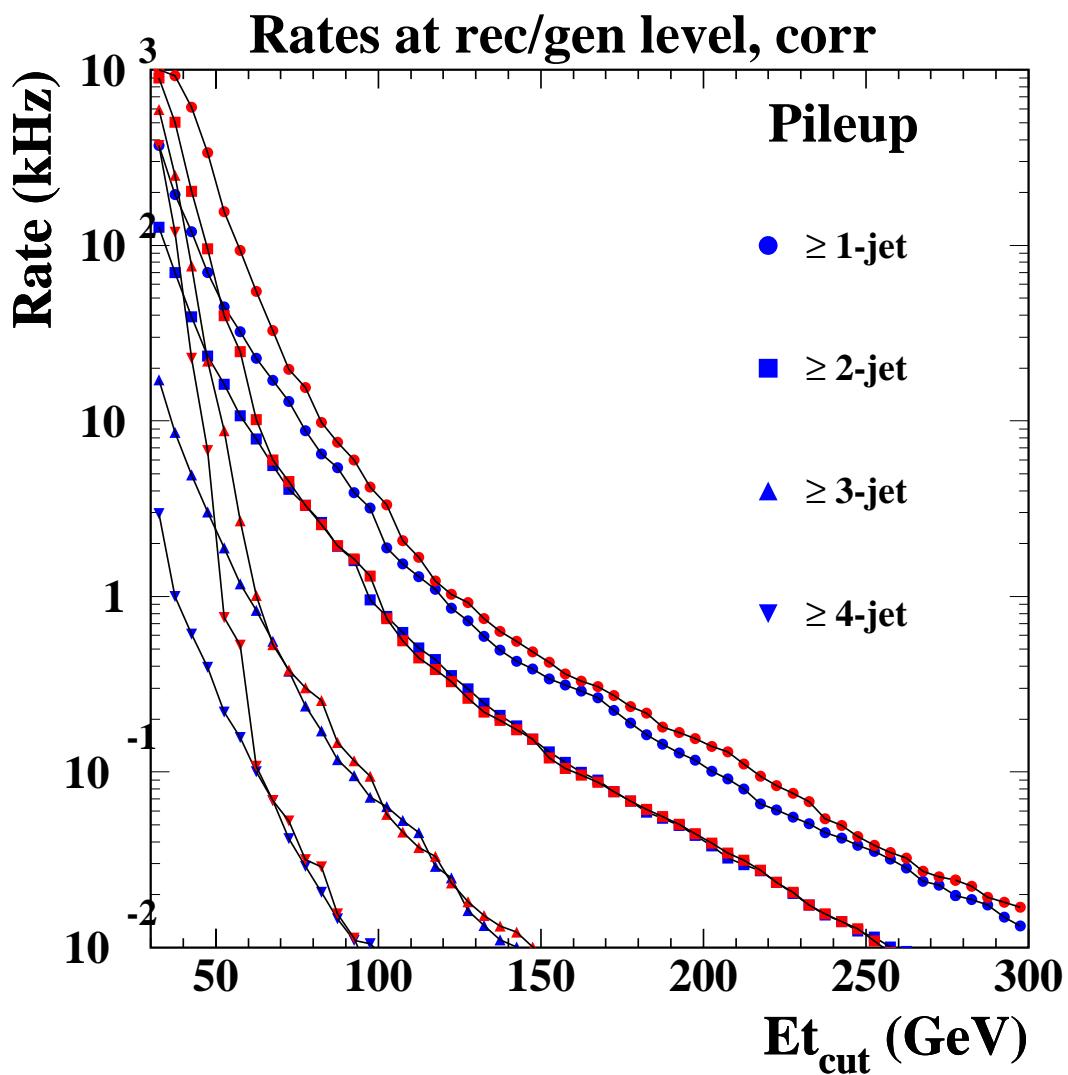


Jet Trigger rates after corrections



Jet trigger rates at reconstructed level much closer to the generated level rates

Jet Trigger rates - pileup



- Corrections account for pileup contribution to “genuine” jets
- Rates in reasonable agreement with particle-level rates above 70 GeV

Conclusions

- Average Jet Energy scale after corrections consistent with one within 1-3% over a wide range in E_T (30-400 GeV) and flat over HB+HE region
- When pile-up is taken into account, corrections depend on the cone size. Scale after corrections again consistent with one within 1-3%
- E_T resolution improves after corrections, even if the degradation due to pile-up is not completely recovered

Next:

- Check how corrections work on L1, tau and b-jets
- Extend calibration to HF
- Determine corrections with ORCA4 and with the full available statistics of QCD events